

ASTRAGALUS NUTRIOSENSIS (FABACEAE):
A NEW SPECIES FROM EASTERN ARIZONA

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ABSTRACT

A new species of *Astragalus* from the White Mountains of Arizona is described and its possible relationships discussed. Its unusual morphology combines features found in two western North American sections of the genus. Morphological evidence suggests it is most closely related to species in section *Mollissimi*, although it possesses several character states that are unusual in the context of that section.

A distinctive new species of *Astragalus* has recently been discovered among the mesas along Nutrioso Creek in the White Mountains of eastern Arizona. Easily overlooked because of its dwarf habit and cryptic flowers, it remains a difficult species to study in the field. Two relatively large populations several kilometers apart were found following the wet spring of 1987. The spring of 1988 was unusually dry; population sizes were lower, and the plants were evidently suffering from severe water stress, producing fewer leaves and flowers than in the previous year. Preliminary indications are that the species is a narrow endemic, but a complete survey of its distribution must await a future, more favorable season.

Astragalus nutriosensis Sanderson, sp. nov. (Fig. 1)

Habitu *A. mollissimus* var. *matthewsii* (Wats.) Barneby, sed pedunculis brevissimus; floribus perangustis longis, niveis, apicibus subroseis; fructibus parvis (8–10 mm longis), bilocularibus perfecte, in duo dimidia inaperta findentibus.

Dwarf, tufted, acaulescent, perennial herbs from a well-developed, short but broad, knotty caudex on a simple taproot. Upper surface of leaflets glabrescent-green; herbage otherwise cinereous and covered with spreading, basifixed hairs up to 2 mm long. Leaves 3–11 cm long; petiole usually at least half that length; leaflets 4–8 mm long, 1.5–4 mm wide, in 5–9 pairs, obovate or elliptic, acute or obtuse at apex; stipules 3–9 mm long, deltoid or lanceolate, with prominent green midrib and scarious or hyaline margins. Peduncles (rachises) 0–2(–5) cm long, almost always much shorter than the leaves, and often appearing obsolete, not elongating in fruit; racemes very short, up to 0.6 cm, (1–)2–5(–7)-flowered, the flowers strongly ascending; bracts 2–5 mm long, greenish, narrowly lanceolate; ped-

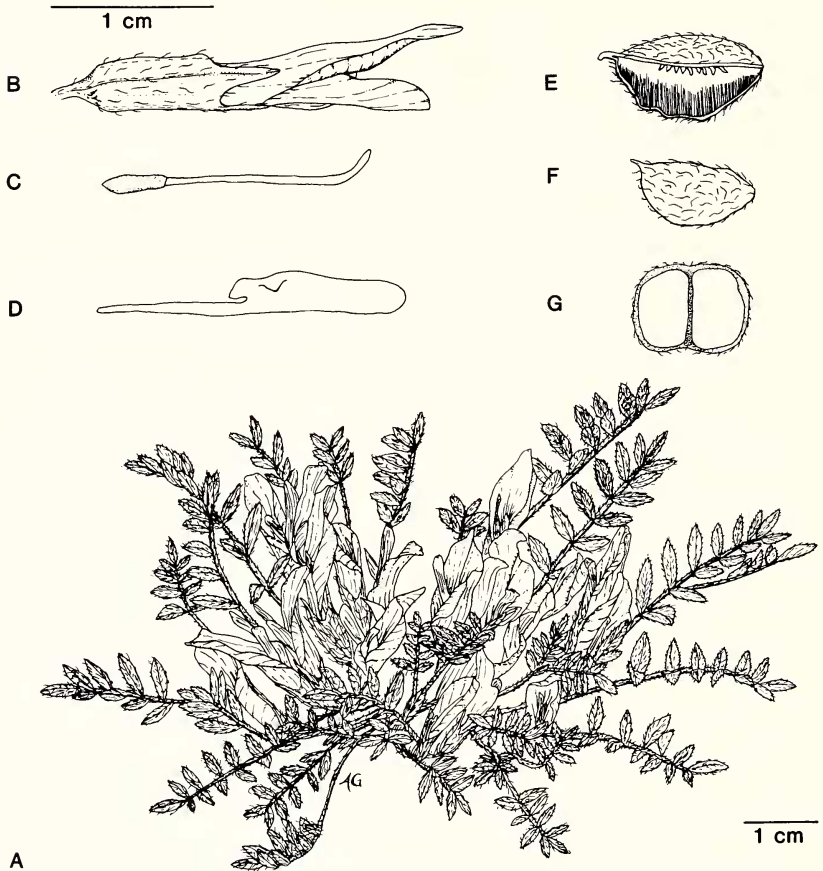


FIG. 1. *Astragalus nutriosensis* Sanderson (Sanderson 551). A. Habit. B. Flower. C. Gynoeceum. D. Wing petal. E. Longitudinal view of "dehiscent" pod showing complete septum with funicular scars. F. Pod, external view. G. Pod, transverse section.

icels 2–4 mm long. Calyx 11–14 mm long, 2–3 mm wide at base of teeth, narrowly cylindrical, pilose with spreading hairs, subsymmetrically attached at base, the receptacle not oblique. Petals white with pink-purple veins and/or tips; banner 20–23 mm long, about 6 mm wide, oblanceolate and emarginate at apex, little recurved (less than 30 degrees); wings 19–22 mm long, blade about 10 mm long, of uniform, narrow width (2 mm), rounded at apex and not at all incurved; keel significantly shorter than the wings, about 14–17 mm long, blade of keel 5–6 mm long, obtuse and longer than wide. Anthers about 0.5 mm long, filaments incurved only very distally.

Ovary unusually short at anthesis (about one-fifth the entire length of the gynoecium), the septal intrusion only partially developed at this time; ovules about 20. Pods small, 8–10 mm long, 6–8 mm wide, almost beakless, broadly half-elliptic in profile, subterete in cross-section, the ventral suture slightly depressed proximally, sessile on receptacle (estipitate), on the very short peduncles, close to the caudex, readily deciduous; valves papery, thin, brownish-gray and covered with spreading hairs, septum complete throughout; dehiscence of fruit by fracture of pod into two closed, carpel-like halves, each half retaining one side of the folded endocarp, the seeds probably eventually escaping through weathered septum walls.

TYPE: USA, Arizona, Apache Co., on hillside ne. of intersection of AZ hwy. 666 and Apache Co. hwy. 116, about 9.5 km n. of Nutrioso, 2270 m (7460 ft), 25 May 1987, *Sanderson 551* (Holotype: ARIZ; isotypes: NY, others to be distributed).

PARATYPE: USA, Arizona, Apache Co., nw. of intersection of AZ hwy. 666 and Apache Co. hwy. 130, 2310 m (7600 ft), 6 km se. of Springerville, and about 8 km from the type locality, 28 May 1988, *Sanderson 706* (ARIZ).

Ecology and distribution. Known only from two localities along Nutrioso Creek in the White Mountains of eastern Arizona. Rare at the type locality, but fairly common at the second locality. Found on volcanic silty-clay soils on gently sloping hillsides; associated with *Bouteloua gracilis* (H.B.K.) Lag. and *Gutierrezia sarothrae* (Pursh) Britt. & Rusby in open grassland, sometimes among pinyon and juniper on slopes. Sympatric with *Oxytropis lambertii* Greene, *Astragalus humistratus* A. Gray, *A. brandegei* Porter, and *A. mollissimus* var. *matthewsii* (S. Wats.) Barneby. Flowering in May, fruiting by late May or June.

Phylogenetic relationships. Several morphological characters of *A. nutriosensis* are shared by certain members of sections *Argophylli* A. Gray and *Mollissimi* A. Gray. These include an acaulescent growth habit, free stipules, basifixed pubescence, long, narrow flowers with barely incurved petals, and a bilocular legume. The finer details of the pod provide the best clues to the relatives of this species. Within section *Argophylli* is a group of four species (*A. waterfallii* Barneby, *A. feensis* M. E. Jones, *A. holmgreniorum* Barneby, and *A. eurylobus* Barneby), all of which have bilocular pods technically similar to those of *A. nutriosensis*. However, the shape, texture, and dehiscence of the bilocular pod in these four species is fundamentally different. Each is marked by a long, narrow, incurved pod, with trigonous or cordate cross-section (and sometimes incomplete septum), fleshy or ligneous valves, and dehiscence which is first apical, then through ventral and dorsal sutures. The pod of *A. nutriosensis* is short, broad, little incurved, terete in cross-section, completely bilocular, and pa-

pery in texture. Its dehiscence is unusual, involving separation of the pod into two closed halves, the seeds ultimately spilling through the septum walls.

The shape and texture of the pod are more similar to species in section *Mollissimi* A. Gray, particularly to *Astragalus mollissimus* vars. *thompsonae* (S. Wats.) Barneby and *matthewsii* (S. Wats.) Barneby, which are difficult to distinguish in the area of Nutrioso Creek. The dehiscence is similar to that of *A. anisus*, a narrow endemic of the Gunnison Valley, Colorado, of somewhat uncertain phylogenetic position [placed by Barneby in section *Argophylli* (Barneby 1964: 718), but by Jones in section *Mollissimi* (Jones 1923:230)]. Mature plants of *A. mollissimus* are typically much more robust than those of *A. nutriosensis*, but seedlings of the former may easily be confused with specimens of the latter if flowers or fruits are not present. The copious pubescence of *A. nutriosensis*, matched in *A. mollissimus*, contributes to the overall impression of similarity. The pod of var. *matthewsii* is completely bilocular, which, along with a tendency towards a dwarf habit, suggests that it may be the closest extant relative to *A. nutriosensis*.

Astragalus nutriosensis may be distinguished from *A. mollissimus* var. *matthewsii* by several characters: a much smaller pod, barely half the length of typical pods of species in the section; an almost sessile inflorescence with few flowers, which is unique in the section and rare among North American groups in general; and white flowers with barely recurved banners. These differ from the purple flowers and more reflexed banners characteristic of all other members of the section, except perhaps the recently rediscovered *Astragalus hartmanii* Rydb. from northern Chihuahua (Spellenberg pers. comm.; see e.g., *Hartman 678*, at NY) which is a robust, strongly caulescent, leafy plant otherwise quite dissimilar to *A. nutriosensis*.

Floral morphology. The flowers of *A. nutriosensis* are remarkably straight and narrow, even in the context of the long, narrow flowers typical of sections *Argophylli* and *Mollissimi*. In size and shape the white flowers resemble those of the distantly related section *Orophaca* (Torrey & A. Gray) Barneby and of *A. wittmannii* Barneby, of section *Humillimi* (M. E. Jones) Barneby. The flowers in both those cases are found on very short peduncles crowded together at the bases of the leaves (Barneby 1979). Perhaps this unusual syndrome represents convergent evolution for increasing flower number given the constraints of an inflorescence crowded among leaf-bases.

ACKNOWLEDGMENTS

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NOTES

ADDITIONAL SUPPORT FOR THE RECENT-INVASIVE ADVENT OF MESQUITE (MIMOSA-CEAE: *Prosopis*) IN THE SAN JOAQUIN VALLEY, CALIFORNIA.—In a recent article (Holland, *Madroño* 34:324-333, 1987), I speculated that one or both species of mesquite present in the San Joaquin Valley (*Prosopis glandulosa* and *P. pubescens*) were naturalized sometime between 1870 and 1890. Additional support for the hypothesis of human-mediated establishment of *P. glandulosa* has since been found in an article by Mackie (*Nemophila* 8:30, 1920) from which we quote in part: "Some years ago, Mr. J. A. Jastro, a well-known cattleman, introduced the large-podded mesquite (*Prosopis glandulosa*) into the head of the San Joaquin Valley in Kern County to improve the cattle ranges. The bushes grew from seeds producing less than a dozen individuals. When these specimens fruited the cattle at once began to feed on the pods and in this manner the mesquite was spread over a large area lying between Buena Vista lake reservoir and Button Willow." Haas et al. (*Texas Agric. Exp. Sta. Monogr.* 1:10-19, 1973) have shown that *P. glandulosa* can produce flowers within three years of germination, although other information (Mooney et al., *In* Simpson, ed., *Mesquite: its biology in two desert scrub ecosystems*, 1977) indicates that longer periods may be normal. Given Linton's observation of "an occasional patch of mesquite and sage" on the north shore of Buena Vista Lake in 1907 (*Condor* 10:196-198, 1908), the introduction may have occurred as late as 1900.

Additionally, the statement in the first paragraph of my recent article (Holland, *op. cit.*) concerning the number and distribution of species of *Prosopis* is in error. According to Burkart and Simpson (*In* Simpson, *op. cit.*), the genus contains 44 species, 40 of which occur in the New World.—DAN C. HOLLAND, Dept. of Biology, Univ. Southwestern Louisiana, Lafayette 70504-2451 and BARRETT ANDERSON, Dept. of Botany, California Academy of Sciences, Golden Gate Park, San Francisco 94118. (Received 29 Mar 1988; revision accepted 12 Sep 1988.)